Effects of WIC and Food Stamp Program Participation on Child Outcomes

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Abstract

Both joint or separate participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the Food Stamp Program reduces the risk of child abuse or neglect and several nutrition-related health problems, such as anemia, failure to thrive, and nutritional deficiency. This study examines the relationship between WIC and Food Stamp Program participation and young children's health and mistreatment outcomes. The analysis uses a unique individual-level longitudinal database that links administrative datasets on WIC and Food Stamp Program participation, Medicaid enrollment and claims, and child abuse and neglect reports in Illinois.

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The views expressed are those of the authors and not necessarily those of ERS or USDA. In addition, readers are cautioned that the term "participation" in this study differs from its traditional measure, in that it includes only children who enroll in WIC or the Food Stamp Program prior to being diagnosed with any of the outcomes under study. Children who enroll in WIC or the Food Stamp Program after a diagnosis are included in the "nonparticipant" category.

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Summary

This study examines the relationship between WIC and Food Stamp program participation and young children's health and maltreatment outcomes, utilizing a unique individual-level longitudinal database linking administrative datasets on WIC and Food Stamp program (FSP) participation, Medicaid enrollment and claims, and child abuse and neglect reports in Illinois. The main goal of the study is to isolate more accurately the program participation effects by employing three different approaches: sibling fixed-effects model, two-stage instrumental variables model, and multilevel hazard model. With the data utilized for the study, we find the sibling fixed-effects model and the multilevel hazard model work better for neutralizing the selectivity. Overall, we find no evidence of selection bias in the identified relationships between WIC and FSP participation, jointly or alone, and the majority of key dependent variables examined in the study.

Using traditional regression methods (Ordinary Least Square methods), the data show that any of the three program participation types (joint WIC and FSP, WIC only, and FSP only) is associated with a lower risk of abuse and neglect reports, and of diagnosis of several nutrition related health problems such as anemia, failure to thrive, and nutritional deficiency. When we control for the possible selection bias using sibling fixed-effects models, the results were essentially unchanged suggesting no evidence of selection bias in the OLS results.

Taking full advantage of the longitudinal nature of the data, we also employed multilevel hazard models in the study. The findings in the multilevel hazard models are especially noteworthy because the models specifically take into account the timing of the events. Even after controlling for unobserved heterogeneity in most of the multilevel hazard models, the results show a statistically significant relationship between participation in WIC and FSP, jointly or alone and lower level of abuse/neglect and several nutrition related health problems. The findings about the lower risk of abuse and neglect is significant because it offers some evidence that participation in programs such as WIC and FSP that offer family supports not directly aimed at preventing child abuse and neglect may protect children.

The findings of the relationships between WIC and FSP participation, jointly or alone, and lower risk of being reported and substantiated for child maltreatment and lower levels of health problem are significant indicators of the benefits of WIC and FSP participation among low-income young children.

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Introduction

The Personal Responsibility and Work Opportunity Act of August 1996 significantly altered the basic safety net for low-income families with children. This conversion of the AFDC entitlement program into state block grants, the introduction of federally mandated time limits and work requirements as a condition of welfare receipt, and increased state flexibility in designing and implementing antipoverty programs is likely to affect the well-being of children and families in different ways. During this period of shifting U.S. welfare policy, there has been growing interest in better understanding the role of other non-cash assistance programs in mitigating the effects of poverty on children.

Although the Food Stamp Program (FSP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) are two prominent, federally funded nutrition assistance programs for families with young children, very little systematic knowledge exists about the effects of the two programs on young children's outcomes. This study aims to help fill this research gap by examining the effects of WIC and FSP participation on young children's health and maltreatment outcomes. The study utilizes a unique state-level longitudinal database linking administrative datasets on WIC and Food Stamp program participation, Medicaid enrollment and claims, and child abuse and neglect reports in Illinois.

The study builds on earlier work of the authors that examined the participation patterns of children in the two programs and their effects on child health outcomes in Illinois (Lee, Mackey-Bilaver, & Goerge, 2000). The previous study found that while families with young children are forgoing food stamps during the period of welfare reform, they may be turning more to WIC for essential food items for their young children. The previous study also found that the receipt of WIC benefits lowers the probability of developing health problems associated with inadequate nutrition, such as failure to thrive or nutritional deficiency, among low-income children. Given the significant changes in program participation in WIC for families with young children, we need a better understanding of the effects of WIC on a wider range of child outcomes.

Much of the previous work examined the effects of WIC alone on health and such nutritional outcomes as anemia, nutrition intake, prenatal care, birth weight, and breast-feeding. To the best of our knowledge, there has been no systematic study of the effects of multiple program participation (WIC and FS) on outcomes for young children. Furthermore, very few of the previous WIC studies considered the potential effects of WIC participation on child developmental measures at later ages or on parenting behaviors. As pointed out recently in the literature (see, for example, Currie, 1996; Owen & Owen, 1997), much more research is needed to examine the potential effects of WIC on a wider range of child outcomes.

Another critical limitation of much of the previous research is the failure to address the possible selection bias problem (see Besharov & Germanis, 1999; Besharov & Germanis, 2001). Previous studies have not adequately controlled for the range of alternative socioeconomic and demographic characteristics that may predict both

program participation and later outcomes. For example, it could be the case that those mothers who are more concerned about the welfare of their children are, at the same time, more likely to apply for and receive WIC and more likely to have healthy children. In other words, those mothers who seek out WIC might, in ways not measured in the studies, differ from those who are eligible but do not participate. This is generally known as "selection bias."

Our study aims to examine the effects of WIC and FSP participation, jointly or alone, on a wide range of child outcomes while addressing the limitations of the previous research. Specifically, the main research questions of the study are:

- What are the effects of WIC and FSP participation on reducing the incidence of young children's health problems?
- What are the effects of WIC and FSP participation on reducing the incidence of parent/child interaction problems that result in child maltreatment?

We examine the above research questions by following all Illinois children who were born between 1990 and 2000, and enrolled in Medicaid within a month from birth. We address the limitations of the previous research by employing improved data and statistical methods. Our approach is to utilize the hierarchical nature of the data so that it is conceptualized that the children are nested within a mother and the mothers (families) are nested within a community. Taking full advantage of this data structure, we examine the effect of program participation on outcomes at the individual child level while correcting for the potential selection bias using several statistical approaches, such as sibling fixed-effects models, two-stage instrumental variables approach, and multilevel hazard models.

Background of Food Stamp Program and WIC

The WIC program provides not only food assistance but also nutrition education and counseling and referral services to low-income pregnant, postpartum, and breast-feeding women, and infants and children up to age 5. Along with the income eligibility requirement (185% of the poverty line), all participants must be considered nutritionally "at risk." WIC provides eligible families with monthly vouchers (usually in the form of checks that can be used at retail grocery stores) that enable them to obtain a specified nutrient-rich package of food. The food packages are designed to supply specific nutrients lacking in the diets of the targeted participants. Unlike the FSP, which is an entitlement program, participation in the WIC program is limited by appropriated federal funding. It saw no changes under welfare reform.

With the redesign of AFDC as Temporary Assistance for Needy Families (TANF) under welfare reform, the Food Stamp program has become one of the most important components of the public assistance safety net for low-income families. Families eligible for food stamps must have incomes below 130 percent of the federal poverty line. Benefit levels are determined by household size and income. The most recent data indicate that federal spending for WIC was $4.37 billion, and the program served a monthly average of 7.5 million women, infants, and children (U. S. House, 2004). In 2002, the Food Stamp program served 19.1 million individuals, and the program

expenditures totaled about $24 billion (U. S. House, 2004). The importance of the Food Stamp program as a safety net for children is evident in the number of children who are served by the program. At any time, one can assume that one-half of the caseload is children (GAO, 1999). Unlike AFDC, the Food Stamp program was essentially preserved under welfare reform, with restrictions applied mainly to able-bodied adults with no dependents. Although it was designed primarily to help low-income households maintain a nutritionally adequate diet, the Food Stamp program resembles a cash benefit program more than the other nutrition programs, such as WIC, because Food Stamps often substitute for other cash income when purchasing food. It is estimated that about 70 percent of Food Stamp benefits are used to divert household cash income to nonfood expenditures (Devaney, Ellwood, & Love, 1997)

Previous Research

Since its advent, many studies have investigated the effects of WIC participation on selected infant and child health outcomes. The bulk of this work was undertaken in the late 1970s and the 1980s, and it has largely focused on outcomes targeted by the program via its supplemental foods and nutrition education/counseling, which are designed to ameliorate a variety of risk factors affecting pregnancy outcomes, such as nutrient intake, anemia, breast-feeding, prenatal care, birth weight, and gestational age. Although the reliability of the conclusions that can be drawn from much of this work is uncertain, as will be discussed below, the research has for the most part found that the WIC program has had beneficial effects on the health of mothers and children. Less research on the health effects of the Food Stamp program has been undertaken. Much of the research has focused on economic impacts, and studies investigating health impacts have looked mainly at nutrient intake.

The positive effect of WIC participation on measures of nutritional sufficiency has been one of the most consistent findings in the research. The earliest evaluation of WIC (Edozien et al., 1979) found decreased rates of anemia among participants, and subsequent studies found further evidence of this effect (Yip et al., 1992; Rush, 1986). Basiotis et al. (1998) examined the diets of WIC participants using the USDA Healthy Eating Index and found marked improvement. Other studies (Rose, Habicht, & Devaney, 1998; Fraker, 1990a; Rush, 1986) found a positive impact on intake of specific nutrients. The literature suggests that the WIC program has, for the most part, benefited families, especially by its contribution to the health of mothers and children (Basiotis, Kramer-LeBlanc, & Kennedy, 1998; Cook et al., 1995; Devaney, Haines, & Moffit, 1989; Devaney & Moffitt, 1991; Gordon & Nelson, 1995; Rush et al., 1988; Suarez, Simpson, & Smith, 1997).

Research on the impact of Food Stamp participation on nutrient intake has yielded more mixed results. Although older studies found no consistent benefits (Cook et al., 1995; Fraker, 1990b; Rush, 1986), more recent work has identified clear effects. Analyzing data from the Continuing Survey of Food Intake by Individuals, Rose, Habicht and Devaney (1998) found increases in the intake of five nutrients among preschool children who received food stamps. Devaney and Moffitt (1991), examining food energy and nutrient availability at the household level, found significant effects of Food Stamp participation across a range of ten nutrients.

Most studies investigating the effects of WIC on birth outcomes, such as birth weight, gestational age, and the incidence of premature birth, have found benefits associated with WIC participation. The link between program participation and these outcomes has been of particular interest because low birth weight and premature birth have been associated with subsequent problems in children's health and development (see, for example, McCormick et al., 1992). The beneficial impact of maternal WIC participation during pregnancy on birth weight has been reported in a host of studies (Edozien et al., 1979; Kennedy et al., 1982; Devaney et al., 1992; Kowaleski-Jones & Duncan, 2000), and a few have reported increased gestational age and decreased incidence of preterm birth (Devaney et al., 1992; Kotelchuck et al., 1984). Studies also have found that participants had better pregnancy outcomes (Ekechuku, 1989). A 1989 evaluation of WIC found that those not participating in WIC were two to three times as likely to have received inadequate prenatal care. WIC participation was also linked to increased birth weight and lower incidence of preterm births (Mathematica, 1989).

A few studies have gone beyond nutrient intake and birth outcomes to investigate the effects of WIC participation on other child outcomes. Kowaleski-Jones and Duncan (2000) studied the relationship between WIC participation and infant temperament and infant motor and social skills, finding evidence for a positive effect on temperament. Using sibling fixed-effects models, they report that parental WIC participation is associated with a 3.7-point decrement in difficult child temperament reported by mothers. Lee et al. (2000) found that, among Medicaid-eligible children, children who participated in WIC were about 36 percent less likely to be diagnosed with failure to thrive than children who had not participated. The same study also found that the effect of WIC participation was even stronger for being diagnosed for nutritional deficiencies, where participation lowered the odds of the diagnosis by 74 percent (Lee, Mackey-Bilaver, & Goerge, 2000). Children who participated in WIC were also 36 percent more likely to receive Early Periodic Screening, Diagnosis and Treatment (EPSDT) service when compared with children who did not participate in WIC (Lee, Mackey-Bilaver, & Goerge, 2000). Hicks, Langham, and Takenaka (1982) found that children whose mothers received WIC services during pregnancy showed increased verbal ability. One of the earliest studies (Edozien et al., 1979) found that WIC participation impacted growth in the first year of life.

To the best of our knowledge, there has been no study that examined directly the effect of WIC and FSP on child maltreatment. However, the literature on child maltreatment and WIC effects suggests a possible link between the two. By securing essential food items for their children, mothers participating in WIC may lower the risk of neglecting or abusing their children. In many states, including Illinois, a diagnosis of "failure to thrive" is grounds for a report of neglect to the state's Central Registry. The lack of physiological development captured in a nonorganic failure-to-thrive diagnosis signals a problem with the nurturing environment provided by the caregiver. Central to the nurturing environment is the provision of adequate food, but it also includes adequate rest, stimulation, and protection (Haynes, 1983). Although WIC or FSP may directly lower the risk of failure to thrive in young children by providing food items, there may also be indirect benefits of WIC participation because it connects mothers to health services, including well-child care services.

Despite the seeming consistency of these findings relating WIC and Food Stamp

participation to health benefits, one of the lingering problems facing research into the effects of program participation has been the issue of selection bias. Because of ethical considerations precluding the use of randomized experimental methods, most researchers have attempted to isolate the effects of the program by comparing the outcomes of participants with those of nonparticipants and controlling for observable individual differences using multivariate statistical methods. However, as has been pointed out by Besharov and Germanis (1999) and others, this still leaves room for bias due to unmeasured heterogeneity—unobserved differences in individual characteristics that may be correlated with both program participation and outcome measures.

Although statistical methods to correct for this potential bias exist, only a few studies have attempted to utilize them in investigating the effects of WIC and Food Stamp participation. Kowaleski-Jones and Duncan (2000) used a sibling fixed-effects model to control for mothers' unobserved characteristics. Comparing this approach with ordinary least squares (OLS) estimates, they found positive effects of prenatal WIC participation on birth weight and infant temperament, but also evidence of selection bias in the OLS results. Rose, Habicht, and Devaney (1998) utilize a two-stage least squares approach in their study of the effects of Food Stamp and WIC participation on preschool children's nutritional intake. Controlling for unmeasured heterogeneity by modeling mothers' WIC participation separately using variables unrelated to the outcome measures, they found that WIC participation was associated with increased levels of intake of ten out of fifteen nutrients. No evidence of selection bias in OLS results was found. Similarly, Devaney and Moffitt (1991), studying the effects of Food Stamps on household nutrient availability, found that their results were essentially unchanged when utilizing a simultaneous equations method to correct for selection bias.

Hypotheses

This study uses individual-level, linked administrative data to examine the effects of WIC and FSP participation on reducing incidence of young children's health problems such as failure to thrive, anemia, and nutritional deficiencies; and on the likelihood of maltreatment or abuse among children.

Our first research question is the following: What are the effects of WIC and FSP participation on reducing the incidence of young children’s health problems?

One of the primary objectives of the WIC program is to promote the health of young children through its supplemental foods and nutrition education. As discussed in the previous section, the literature generally suggests that WIC has helped to alleviate the effects of poverty on low-income children. Building on these earlier findings, we hypothesize that **participation in WIC has a positive effect on the health of low-income children**. More specifically, we posit that participation in WIC is negatively related to the incidence of health problems associated with inadequate nutrition among low-income children. Our dependent variable is defined as having or not having been diagnosed with anemia, failure to thrive, and other nutritional deficiencies such as malnutrition and vitamin deficiencies. We further anticipate that children receiving WIC benefits are more likely to receive regular preventive health care services than are children not enrolled in WIC.

Further, we anticipate that a child’s participation in FSP will result in positive

effects on health outcomes. Although one might not expect that FSP alone will have a significant effect on young children's health outcomes because FSP is a less targeted household assistance (as opposed to WIC, which is one of the most directly targeted and interventionist of the federally funded welfare programs), it could be the case that receiving FSP will have an added benefit for young children because FSP provides needed assistance to other members of the household. In the study, we examine separately the effects of any of the three program participation patterns (joint WIC and FSP, WIC only, and FSP only) to test whether the three program participation patterns have different effect on health outcomes.

Our second research question is the following: What are the effects of WIC and FSP program participation on reducing the incidence of reported child maltreatment?

The literature suggests that parental stress is a factor that can lead to child maltreatment (Howze & Kotch, 1984; Whipple & Stratton, 1991; Kotch et al., 1995). Participation in WIC may contribute to a lower risk of abuse and neglect by reducing parental stress through its effect on the health status of children who participate. It has been suggested in the literature that the health of children may contribute to abuse, and that abused children are ill more often than children who are not abused (Lynch, 1975). WIC may improve the health of children either directly through the provision of essential food items or through the increased use of health services. Thus, we anticipate that WIC participation will reduce parental stress by reducing food insecurity and increasing child-rearing knowledge. By the same token, we also anticipate that participation in FSP may contribute to a lower risk of abuse and neglect by reducing parental stress by reducing food insecurity.

A recent study on the effect of WIC participation (Kowaleski-Jones & Duncan, 2000) also found that WIC has a positive effect on a child's temperament. Child temperament is also shown to be a significant factor affecting parent/child interaction patterns. Research has shown that difficult temperament is related to an increased risk of child neglect (Brayden et al., 1992). Building on these findings in the literature, we hypothesize that **participation in WIC and FSP can lead to decreased risk of being reported for child abuse and neglect**.

Data and Variables

Source of Data

The primary data are drawn from the Integrated Database on Children's Services in Illinois (IDB). The IDB is a state-level, longitudinal database constructed from administrative data gathered by public agencies that serve children and families (Goerge, Van Voorhis, & Lee, 1994). Specifically, we use individual-level longitudinal service records that were constructed from Medicaid enrollment and Food Stamp data from the Illinois Department of Human Services, Client Database; WIC data from the Illinois Department of Human Services, Cornerstone System; substantiated child abuse and/or neglect report records from the Illinois Department of Children and Family Services; and Medicaid paid claims data from the Illinois Department of Public Aid. The Medicaid enrollment data contain the Medicaid enrollment status of clients, and Medicaid paid claims data contain payment records for medical services paid by Medicaid. Medical

services for public assistance clients are reimbursed primarily through Medicaid. The individual-level Medicaid, Food Stamp, WIC, child abuse/neglect reports, and paid Medicaid claims records were linked by child in order to develop "spells" that corresponded to each research question. For example, the spells for analysis of the relationship between WIC receipt and anemia were defined as the duration from birth to the time of anemia diagnosis or reaching age 5, which ever comes first. In the Multilevel Hazard Models, the spell was censored at age 5 (when there was no event of adverse health outcome until age 5). The program participation variables were coded as time-varying covariates, taking the value of 1 for the periods of program participation.

In addition to the individual-level service data, we also constructed data at the family level from the source data capturing the sibling relationships and the characteristics of mothers.

Because the original data used for this study come from different agency information systems that do not share a common ID, linking data records reliably and accurately across different data sources (public assistance databases and WIC) is an important issue. We employed a process called probabilistic record matching to link individual service records. Probabilistic record matching is based on the assumption that no single match between variables common to the source databases will identify a client with complete reliability. Instead, probabilistic record matching calculates the probability that two records belong to the same client using multiple pieces of identifying information. These "weights" will vary based on the distribution of values of the identifiers. We used full name, soundex name, Social Security number, birth date, gender, race and ethnicity, and county of residence in matching. This method was first developed by researchers in the fields of demography and epidemiology (Newcombe, 1988; Jaro, 1985, 1989) and is known as the most reliable means of matching records across multiple data files under conditions of uncertainty.

Because most of the administrative records contain some kind of geographic information (such as a mailing address, neighborhood, or county of residence), we use this information to assign a geocode. This geocode contains a latitude and longitude that correspond to U.S. Census data contained in the Tiger database. Based on these geographic coordinates, we were able to identify census tracts of the addresses of the study population. Furthermore, address records of both the study population's home and DHS office/WIC local agencies or clinics are geocoded to allow us to calculate the distance between a family's home and the DHS office/WIC application centers. There were a total of 134 DHS district offices managing food stamp programs in the state. The number of WIC application centers in the state was 317.

We used 2000 U.S. Census and vital statistics data to construct community contextual variables at the census tract level that we believe will influence the multiple program participation patterns and child outcomes proposed in the study.[1]

Study Population

[1] The study's base population is birth cohorts from 1990 through 2000. Thus, most services were received and most effects on outcomes realized between 1990 and 2000. Because there is a very strong correlation between the 1990 and 2000 Census measures we utilized in the study, we use 2000 Census data. There are no census tract level data available between the Census years.

The base population for the study is all Illinois children who were born between 1990 and 2000, and entered Medicaid within a month of birth. We focus on Medicaid-eligible children because our key health measures are available only through Medicaid claims data. Because we use Medicaid claims data for our measures of the incidence of health problems and the timing of EPSDT visits, we would not be able to observe any health-outcome events while the child was not enrolled in Medicaid. Hence, we limit our base population to those who enrolled in Medicaid within their first month of life.[2] We identified 388,216 children who met the above selection criteria. Of these 388,216 children, we were able to identify mothers in the data for 360,529 children (about 93% of the total population). We further limited our study population to those children with mothers. As a result, we identified the final study populations of 360,529 children and their 286,670 mothers. This final study population represents about 36.9 percent of all Illinois children (977,322 children) who were born between 1990 and 2000 and entered Medicaid during the same period.

We follow this base population to the end of 2001, tracking their WIC and FSP program participation and the incidence of health problems associated with inadequate nutrition, the timing of the first well-child EPSDT visit, and substantiated child abuse and/or neglect reports.

For the sibling-fixed effects models, we selected children who had one or more siblings also born between 1990 and 2000, and enrolled in Medicaid within a month from birth. There were 134,991 children who met the selection criteria. These children were from 61,132 mothers. Of this group, we selected 15,882 sibling groups in which siblings differed in their WIC program participation status. There were a total of 36,277 children in the selected sibling groups. Thus, all eligible children did not participate in the WIC program in about 26 percent of the WIC households with more than one eligible child.

Variables

The incidence of health problems associated with inadequate nutrition is measured by ICD-9-CM codes identified as the primary diagnosis in the Medicaid claims data. Two of the health outcomes that we examine are drawn from categories defined by the Clinical Classification Software provided by the Agency for Health Care Policy and Research (Agency for Health Care Policy and Research, 1999). The two outcomes include anemia and nutritional deficiency. Nutritional deficiencies include such conditions as malnutrition and vitamin deficiencies. Failure to thrive refers to a diagnosis of lack of normal physical development.

Receipt of regular preventive health care services (EPSDT) is also identified using primary diagnosis codes and service category in the Medicaid claims data. Through this process, we identify the timing of the receipt of well-child care service as a

[2] Because we restrict our study population to those who enrolled in Medicaid within their first month of life (which represents about 37% of all Illinois children who were born between 1990 and 2000 and enrolled in Medicaid at some point during the same period), the study population can not be regarded as the representative population of all Medicaid children. Rather, the study population should be regarded as representative of those children who were born to Medicaid mothers or those who were in low-income at the time of birth and had mothers enrolled in Medicaid right after the child's birth. Still, the fact that almost 40% of the entire Illinois Medicaid children belong to this study population definition suggests that significant proportion of the Medicaid children begins their Medicaid enrollment very early in life.

part of the (EPSDT) services required of state Medicaid programs through Title XIX of the Social Security Act. In Illinois, the program that covers well-child services is called Healthy Kids.

The incidence of child maltreatment is measured by substantiated child abuse/neglect reports recorded in the Illinois Department of Children and Family Services abuse/neglect tracking system. We code the substantiated maltreatment allegations including both abuse and neglect in one variable: abuse and/or neglect.

The dependent variables are coded as binary variables with a value of 1 indicating an occurrence of event of interest for OLS regression models[3] employed in the study. For multilevel hazard models, the dependent variables are the durations from entry to Medicaid to the first occurrence of an event of interest.

The primary independent variable is WIC and FSP participation status. We categorize the program participation status in four groups: joint WIC and FSP, WIC only, FSP only, and none. The resulting independent variables are three dummy variables of joint WIC-FSP, WIC only, and FSP only. The variables take the value of 1 when the child has received WIC-FSP together, WIC only, or FSP only before age 5, respectively. The reference category is no service group.

When the effect of receiving WIC on child outcome is considered, one must take into account the fact that children who have certain outcomes might be more likely to receive WIC because an eligibility requirement of the program is being nutritionally "at risk." For example, if we simply compare the rates of a health problem between the program participants (here including those who started participating in the program because of the "bad" health outcome) and non-participants, the observed rate among the participants might be higher than the "true" rate to the extent that the bad health outcome triggers signing up for the program. This would result in 'underestimation' of the program effect on lowering the rate of health problem. To "correct" this possible bias, we only consider WIC and/or FSP participation before occurrence of a particular event as the indicator of WIC and/or FSP participation.[4] It should be also noted that the cause should precede the effect in time to infer a causal relationship between the two events, where the program participation (or no participation) being the "cause" and the child outcomes being the "effect" in the study.

We present several hypothetical situations involving being diagnosed for anemia and WIC and FSP participation below to better illustrate our coding schemes:

Birth → Anemia → WIC participation → Age 5	: WIC only=0; Anemia=1
Birth → Age 5	: WIC only=0; Anemia=0
Birth → WIC participation → Anemia → Age 5	: WIC only=1; Anemia=1
Birth → WIC participation → Age 5	: WIC only=1; Anemia=0
Birth → WIC → FSP → Age 5	: Both =1; Anemia=0

[3] We use ordinary least squares regression instead of logistic regression despite the fact that the dependent variable is a binary variable, because our main purpose is to compare the results with the selection models (sibling fixed-effects and IV models) that are estimated using the linear least squares approach.

[4] This approach still might underestimate the program 'effect.' For example, if a child signed up for the program because health outcome became evident and then "officially" diagnosed as having the health problem, that child will be recorded as having received WIC and having a health problem. Since we do not have a measure to observe the "evident" health problem before signing up for WIC, we still overestimate the rate of health problem incidence among the participants in this case.

Birth → WIC → Anemia → FSP → Age 5 : WIC only=1; Anemia=1

As shown above, if we find that a child started receiving WIC benefits after a particular diagnosis occurred in the matched Medicaid paid claims and WIC data, our WIC participation variable takes the value of 0. Only that WIC certification we observe before the event of diagnosis is coded as 1.[5]

For our hazard models, the three dummy variables of joint WIC-FSP, WIC only, and FSP only are coded as time-varying covariates, taking the value of 1 when the child is receiving WIC-FSP together, WIC only, or FSP only, respectively.

The covariates describing the individual child's characteristics include gender, race/ethnicity, birth order, mother's age at birth, and birth year. Gender was coded as a dummy variable with a value of 1 indicating a female. Race and ethnicity were coded as non-Hispanic white, African American, Hispanic, and other. Mother's age at the time of child's birth and birth order are measured as integer values. Birth cohort variables representing the year of birth are defined as a set of 10 dummy variables, using 1990 as the comparison year.

The covariates describing the mother's characteristics include level of education, marital status, and employment experience. Level of education was coded as a dummy variable with a value of 1 indicating being a high school graduate or having a GED. Marital status was grouped into three categories: currently married, never married (comparison group), and divorced or widowed. Past work experience was coded as a dummy variable having a value of 1, indicating some work experience. We use past work experience and the level of education as indicators of a mother's human capital characteristics. By definition these mother's characteristics can change over time. These variables were measured at the point of program entry in the study.

The geocodes of the addresses in the data allowed us to (1) calculate the distance between the family's home and the WIC application place and/or DHS office, and (2) associate community characteristics to a family's address using census tract as a geographic identifier. Following is a list of community characteristics employed in our study from the 2000 Census and Illinois vital statistics data.[6] [7]

[5] While this approach reduces the chances of underestimating the program participation effect, it might cause a different type of selection bias, i.e., overestimating the program participation effect. Refer to Appendix A for further discussion of coding scheme used in the study.

[6] Since vital statistics data are available each year, we use an average measure of each vital statistics indicator from 1990 to 1998 (the most recent year when the data are available) in the analyses.

[7] We also examined proportion of population that are not English-speaking, proportion unemployed, proportion of single mother families, and proportion of births to teen mothers as covariates. After examination of correlations between these variables and the ones used in the modeling, these variables were dropped from the models due to their high correlations with the other variables included in the models.

NEIGHBORHOOD-LEVEL CHARACTERISTIC (at the census tract level)
2000 U.S. Census Measures
Proportion of Blacks and Whites
Proportion of population with high school diploma or GED
Proportion of households below poverty line
Proportion of population that are noncitizens
Proportion of households with more than one residence between 1995 and 2000
Illinois Vital Statistics Measures
Proportion of low birth weight
Proportion of births to teen mothers
Proportion of births without adequate prenatal care (defined as not starting prenatal care in the first trimester)

Statistical Methods: Model Specification

As discussed earlier, we must be careful in inferring any causal relationships between program participation and health outcomes because of potentially severe "selection bias" problems. Especially with WIC participation, there could be two possible types of selection bias in play. First, those mothers with a heightened concern about the health of their children are, at the same time, more likely to apply for and receive WIC and are more likely to have healthy children. In this case, the estimated effect of WIC would be an overestimate of the "true" program participation effect. As a strategy to account for this type of selection bias, we employ two separate approaches: sibling fixed-effects models and two-stage least squares regression with instrumental variables. On the other hand, it may be that children who participate in WIC could be systematically at greater risk of health problems because the WIC program is primarily targeted to low-income children with nutritional risk. If this holds true, when the effect of WIC on those health outcomes is examined by comparing program participants and nonparticipants, the effect of WIC program participation would be underestimated. In order to account partially for this source of potential bias, one would need information on prenatal or infant health measures. Unfortunately, the Medicaid claims data did not include such information. As an alternative, we include infant health measures (low birth weight, teen births, and inadequate prenatal care) at the census tract level to control for health status of the study population. In our analysis, we also estimate a multilevel hazard model to examine the macro community, family, and child level effects on the timing of our outcomes of interest. By employing the three distinct approaches to examine the program participation effects on an array of health and maltreatment child outcomes, we test the robustness of the results across different approaches. Below, we

describe each approach in detail.

Fixed-Effects Models

A general model of the relationship between program participation status and an outcome variable (such as being diagnosed for a nutritional deficiency) can be shown as

$$Y_{ij} = \alpha X_i + \beta_1 X_{ij} + B_2 P_{1ij} + B_3 P_{2ij} + B_4 P_{3ij} + \mu i + \varepsilon ij$$

where $i = 1, 2, \ldots, n$ denotes the family unit to which the sibling groups belongs, and $j = 1, 2, 3, \ldots, Ji$ denotes the individual sibling in the family unit.

In the above equation, y is the outcome of interest; P_1, P_2, and P_3 are the program participation indicators that take 0 or 1 value respectively for WIC-FSP together, WIC only, and FSP only; X represents a vector of individual child characteristics such as birth order and mother's age at birth; and X_i represents the family-specific characteristics (both observed and unobserved). The main approach employed in the sibling fixed-effects model is to differentiate the above equation across siblings. Because the family-specific characteristics that are constant within the family unit cancel out across siblings within the family unit in the estimation process, we can net out the biasing effect of family and maternal characteristics both observed and unobserved on $_2$, which denotes the program participation effect.[8] We use STATA statistical software to estimate the fixed-effects models.

Two-Stage Least Squares Regression and Instrumental Variables

Along with the fixed-effects models we described above, we use standard selection models. This approach requires one or more variables that are correlated with whether an individual child participates in the program but not with outcomes of interest. This procedure attempts to control for the unobserved heterogeneity that affects both program participation and the outcome of interest.

Exclusion restrictions in the outcome equation are the key to identification without relying on particular functional forms. In other words, having variables in the participation equation, but not in the outcome equation, allows the control function to vary differently from the participation dummy in the outcome equation. We employ one such exclusion restriction: distance between the family's home and the WIC application place and/or DHS office.

For example, compare a family living a great distance from a local WIC agency with a family that lives next door to such an office. The family next door to the WIC office is more likely to use WIC, all else equal; but there is no reason to believe that

[8] Another important consideration is that sibling-to-sibling variation in WIC participation during the study period in Illinois (especially in the Chicago area) may be in large part due to the exogenous program expansion effects. For example, Illinois implemented the WIC Food Centers program as a pilot program in Chicago, making the receipt of WIC service more community-based and user-friendly. Due in part to this strong outreach program, WIC participation increased about 10 percent between 1993 and 1996 (Lee, Mackey-Bilaver, & Goerge, 2000).

living within close proximity to the office will make a child more likely to have positive outcomes.[9] We use STATA statistical software to estimate the two-stage least squares models.

Multilevel Hazard Models

Our final statistical approach is based on a multilevel hazard model (see Lillard, 1993; and Lillard and Panis, 1998). With this model we want to explore the effect of WIC and/or FSP receipt on the timing of the diagnosis of anemia, failure to thrive, nutritional deficiencies, or child abuse or neglect. We expect that children who receive WIC, especially, will have a lower estimated hazard of these outcomes. The basic premise of the model is to extend the failure-time hazard framework to the multilevel context – individual child, family, and community. The model relies on full information maximum likelihood estimation and assumes a normally distributed error component.

The primary dependent variable is the time from entry to Medicaid to the first occurrence of outcome events of interest (i.e., being diagnosed with anemia, failure to thrive, or nutritional deficiency; having first EPSDT prevention service visit; and being reported for child abuse or neglect). Using the dependent variable of being diagnosed with failure to thrive as an example, we show the model to be estimated below. Timing of being diagnosed with failure to thrive is represented by a continuous-time log hazard equation at time t for child k in family h in community (census tract) c:

$$\ln h_{chk}^{1st}(t \mid \quad , \; , \quad) = \quad _0 + \quad _1 t + \quad _2' \quad _{chk} + \quad _3' \quad _{chk} t + \quad _4' \quad _c + \quad _5' \quad _{ch} + \quad _6' \quad _{chk} + \quad _c + \quad _{ch}$$

For the nested structure $c = 1, \ldots, N$, $h = 1, \ldots, N_c$, $k = 1, \ldots, N_{ch}$. X_{chk} represents a vector of individual child-level covariates including the dummies of the program participation indicator. Three dummy variables are constructed to indicate the program participation statuses at a given month: WIC only, FSP only, and WIC and FSP joint participation. If diagnosis occurs before program participation begins, the duration spell is censored at the time of diagnosis.

Following the general model suggested by Lillard and Upchurch (1999), this is a modified Gompertz log hazard function incorporating both proportional and non-proportional effects of covariates X_{chk}. In the model, covariates include multilevel measures of the characteristics of children (k) within families, families (h) within census tracts, and the census tracts (c). The second term in the equation represents age dependence, which may be affected by covariates, $\quad _1 t + \quad _2' \quad _{chk} t + \quad _3' \quad _{chk} t$. The next three terms represent the proportional effects of covariates (including program participation dummy variables), $\quad _4' \quad _c + \quad _5' \quad _{ch} + \quad _6' \quad _{chk}$. The last two terms represent the effects of unmeasured factors at both the community and family levels, $\quad _c + \quad _{ch}$.

The multilevel hazard models are estimated by aML software developed by Lillard and Panis (2000).

[9] However, if the WIC office is in a health center, the distance might be correlated with health outcomes. We could not control for such cases in the study.

Findings

Study Population Characteristics

Table 1 presents the overall characteristics of the study population. There were 388,216 children who were born between 1990 and 2000, and were enrolled in Medicaid within a month of birth. Because the trend of total births in Illinois has been stable during this period, the trend in birth cohort numbers mainly represents changes in Medicaid enrollment during the period. Consistent with the overall child Medicaid enrollment data in Illinois, we find that the size of the study population birth cohort increased in the early 1990s and then began to decline from 1995. It reached the lowest level in 1998 and increased up to the 1993 level in 2000. Among the study population, about 40 percent were Whites and 40 percent were Blacks. The other 20 percent represented Hispanics. A very small proportion (about 2%) represented the "other" category. There were slightly more boys than girls in the study population (51% vs. 49%). About 43 percent were first-born children and 25 percent of the children were born to teen mothers. Fifty-seven percent of the children had mothers with a high school diploma or GED, and about half the mothers in the study population reported having some work experience before enrolling in Medicaid. With regard to the marital status of the mothers, we find that a majority of the children had mothers who were never married (about 64%).

Table 1. Characteristics of Study Population

Variables	Percentage
Birth Year	
1990	8.1
1991	9.0
1992	9.5
1993	11.2
1994	11.3
1995	10.6
1996	10.2
1997	7.0
1998	6.4
1999	7.3
2000	9.4
Race/Ethnicity	
White	39.6
Black	38.5
Hispanic	20.0
Other	2.0
Gender	
Male	51.2
Female	48.8

Birth Order	
1st	42.7
2nd	27.6
3rd+	29.7
Mother's Education	
High School Graduate or GED	56.5
Mother's Marital Status	
Never Married	64.1
Married	30.2
Divorced/Widowed	5.7
Mother's Age at Child's Birth	
17 and under	7.0
18-19	17.8
20-24	40.1
25-29	20.4
30 and over	14.9
Mother's Past Work Experience	
Some	48.8

We used the full 1990 to 2000 birth cohort study population for the multilevel hazard models where varying lengths of exposure to risk period can be controlled using a censoring method. However, for OLS, sibling fixed-effects models, and instrumental variables models, we only use the birth cohorts from 1990 to 1996 to give the equal period of at least five years of data to be observed. Table 2 presents the same set of study population characteristics for the 1990-1996 birth cohorts along with data broken down by WIC and FSP participation status. We find that the majority of the population participated in both WIC and FSP. Of all study Medicaid children, about 70 percent participated in both WIC and FSP; 13.5 percent participated in FSP only; and 10.2 percent participated in WIC only. A small proportion, about 6.5 percent, did not participate in either of the programs. Comparing demographic characteristics of the study population by the four program participation groups (WIC only, FSP only, WIC and FSP, and none), one finds that more disadvantaged children are disproportionately represented in the FSP participation group. FSP children are more likely to be Black, are less likely to have mothers with a high school diploma (or GED), are more likely to live with never married mothers, and are more likely to have been born to teen mothers. Because the FSP targets a lower-income group by having the eligibility threshold at 130 percent of the poverty line, whereas WIC's eligibility threshold is at 185 percent of the poverty line, the finding of more disadvantaged children in the FSP group (FSP-only and FSP-WIC groups) can be understood as an effect of different eligibility criteria between the two programs.

Table 2. Characteristics of Study Population (in percent)					
Variables	All	WIC Only	FSP Only	WIC and FSP	None
WIC and FSP participation					
WIC Only	10.2				
FSP Only	13.6				
WIC and FSP	69.7				
None	6.5				
Birth Year					
1990	11.7	3.4	13.7	11.9	12.8
1991	12.6	6.6	16.4	12.7	13.4
1992	13.6	9.0	16.0	13.6	15.3
1993	16.2	14.0	16.5	16.6	14.9
1994	16.0	18.4	15.3	15.8	16.6
1995	15.2	20.6	12.6	15.0	14.8
1996	14.7	28.0	9.5	14.4	12.2
Race/Ethnicity					
White	39.0	45.5	38.3	37.0	46.3
Black	43.6	9.1	48.0	50.4	20.9
Hispanic	15.8	40.5	12.5	11.6	28.6
Other	1.6	5.0	1.2	1.0	4.2
Gender					
Male	51.4	50.0	51.7	51.5	52.1
Female	48.6	50.0	48.3	48.5	47.9
Birth Order					
1st	39.3	64.2	32.5	36.1	49.6
2nd	28.1	21.2	18.2	29.3	26.5
3rd+	32.6	14.6	49.3	34.6	23.9
Mother's Education					
High School Graduate or GED	55.0	57.7	51.2	55.3	56.4
Mother's Marital Status					
Never Married	69.0	44.5	68.8	67.6	51.7
Married	26.2	51.0	25.0	26.9	43.2
Divorced/Widowed	4.8	4.5	6.2	5.5	5.1
Mother's Age at Child's Birth					
17 and under	7.6	6.6	7.4	8.0	4.9
18-19	17.5	14.3	17.1	18.4	14.0
20-24	40.1	38.5	39.9	40.0	44.1
25-29	20.6	24.6	20.9	19.8	21.4
30 and over	14.2	16.0	14.7	13.8	15.6
Mother's Past Work Experience					
Some	53.8	24.5	55.2	60.0	31.1

Table 3 presents community characteristics of the birth cohorts 1990-1996 at the census tract level when they entered Medicaid. Examination of the community characteristics also reveals that these children mainly are from disadvantaged communities. Obviously this is expected because our study population is from the

Medicaid population, and Medicaid is a means-tested assistance program. On average, 71 percent of the adult population in the communities had a high school diploma or GED. The communities, in general, have a high proportion of households that moved in the five years prior to the 2000 Census. The average proportion of households with more than one residence in five years was about 44 percent. Nine percent of the population were non-citizens and 21 percent of the population were living under the federal poverty line at

the time of the 2000 Census. In terms of the birth-related health characteristics of the communities, we find that 10 percent of the births, on average, had low birth weights. Twenty-seven percent of the births were to mothers who did not receive prenatal care in the first trimester.

Table 3. Distribution of Community Characteristics		
Variables	Mean	S.D.
Proportion of whites	0.39	0.34
Proportion of blacks	0.40	0.37
Proportion of hispanics	0.18	0.24
Proportion of Asians	0.02	0.04
Proportion of other	0.02	0.01
Proportion of population with high school diploma or GED	0.71	0.14
Proportion of households with more than one residence between 1995 and 2000	0.44	0.11
Proportion of population that are noncitizens	0.09	0.11
Proportion of population that are not English speaking	0.06	0.09
Proportion of households below poverty line	0.21	0.15
Proportion of households that are single-mother households	0.42	0.21
Proportion of being unemployed	0.12	0.09
Proportion of births to teen mothers	0.08	0.04
Proportion of low birth weight	0.10	0.04
Proportion of births without prenatal care in 1st trimester	0.27	0.08
Distance to WIC application centers	1.91	3.14
Distance to IDHS local district offices	2.19	3.83

We also found that the average distance from a WIC application center to a child's home was about 1.9 miles. The average distance from an IDHS office to a child's home was 3.1 miles.

Descriptive Analyses

Table 4 presents means of the study outcome variables by WIC and FSP participation status: joint WIC and FSP, WIC only, FSP only, and none. When we first turn to child abuse/neglect substantiation report rates, we find that the direction of the program participation relationships is as hypothesized. Those who did not receive either service had higher child abuse/neglect substantiation report rates than any of the three program participant groups. These differences were statistically significant. The pattern held true when abuse and neglect reports were combined or examined separately. When the report rates were compared between the WIC-only group and the FSP-only group, we

found the WIC-only group had significantly lower rates than the FSP-only group. The reported rates were similar between the WIC-FSP and FSP-only groups. As we hypothesized earlier, the inverse relationship between WIC and abuse/neglect could be understood in the context of participation in WIC leading to better child-parent interactions through the improved health outcomes of the children and reduced parental stress.

Unlike WIC, the FSP does not provide any counseling or referral services. Also, the FSP targets a lower-income group by having the eligibility threshold at 130 percent of the poverty line whereas WIC's eligibility is at 185 percent of the poverty line. Given the nature of the program, the findings of higher risk of having substantiated abuse/neglect reports for FSP-only and FSP-WIC groups compared to WIC-only group could be understood as simply representing the effects of poverty on child abuse/neglect. In other words, more disadvantaged children are disproportionately represented in the FSP participant group because of different eligibility criteria. The positive relationship between poverty and child abuse/neglect is well documented in the literature.

For the three health outcomes considered in the study (anemia, failure to thrive, and nutritional deficiency), those children who received WIC or FSP, jointly or alone, consistently had lower levels of the health problem than those who received no services. The differences were statistically significant. For the EPSDT services, the results of WIC and FSP participation show different patterns of the associations than we had hypothesized. For both WIC and FSP, the program participants had lower levels of preventive EPSDT service utilization than nonparticipants.

Table 4. Means of Outcomes by WIC and FS Participation

Outcomes	WIC and FSP		WIC Only		FSP Only		None
Abuse or Neglect	0.035	*	0.001	*	0.039	*	0.100
Abuse	0.024	*	0.002	*	0.027	*	0.063
Neglect	0.023	*	0.001	*	0.027	*	0.061
Anemia	0.103	*	0.058	*	0.060	*	0.195
EPSDT	0.783	*	0.686	*	0.522	*	0.905
Failure to Thrive	0.033	*	0.018	*	0.021	*	0.128
Nutritional Deficiency	0.002	*	0.001	*	0.002	*	0.038

* indicates a signficant difference between each program group participants and non-participants at $p < .05$.

We must be careful in inferring any causal relationships between program participation and child outcomes from these descriptive bivariate analysis results. Both observed family and child characteristics and unobserved selection biases discussed earlier might be significant confounding factors yet to be controlled for before drawing any meaningful conclusions. Thus, we turn to multivariate analyses below.

Multivariate Analyses

(1) Ordinary Least Squares (OLS) Regression Results

We present OLS regression results in Table 5. We used OLS regression instead of logistic regression, which is more appropriate for binary dependent variables examined in the study, because the main purpose of the study is to compare the OLS results with the selection models that are to be estimated with the linear least squares approach.[10] Here, we examine the relationship between WIC and FSP participation and five different child outcomes controlling only for the available "observed" child, mother, and community characteristics.

As shown in Table 5, the direction of the relationship between WIC and FSP, jointly or alone, and the child outcomes found in the previous bivariate analyses held true when the available "observed" child, mother, and community characteristics are controlled. There is a statistically significant inverse relationship between any of the three program participation variables (joint WIC and FSP, WIC only, and FSP only) and abuse/neglect rates. The findings on the other control variables are also in the expected directions. Hispanics have lower substantiated child abuse/neglect report rates than do Whites or Blacks. Those children with mothers with a high school diploma (or GED) had lower rates than those with mothers who had not graduated from high school. Those children with mothers who are married also had lower substantiated child abuse/neglect report rates than those with never-married mothers. Higher birth order was also statistically significantly related to higher substantiated child abuse/neglect report rates.

While controlling for other child, mother, and community characteristics, we find only the percent of non-citizens in the tract was negatively related to the substantiated child abuse/neglect report rates. This probably represents the effects of largely Hispanic communities that represent disproportionately more noncitizens in Illinois. Given the fact that race of the individual children is already controlled for in the model, this finding is particularly interesting. This might indicate the influence of community norms with regard to child-rearing practices and child abuse/neglect reporting behaviors that might differ across various ethnic groups.

We also find that participating in the WIC and FSP programs, jointly or alone, is statistically significantly associated with several nutritional health outcomes. Any of the three program participation was found to be inversely associated with the rates of being diagnosed with anemia, failure to thrive, and nutritional deficiency. The relationships were statistically significant. Even after controlling for the other factors, Blacks and Hispanics are statistically significantly at greater risk of being diagnosed with anemia than are Whites. Girls had lower rates of being diagnosed with failure to thrive and nutritional deficiency than boys. In general, children with married mothers seem to be at lower risk of being diagnosed with health problems associated with anemia and

[10] We also ran logistic regression models with the same set of independent variables to compare the results with the OLS results. We find the results of the two approaches in terms of direction and statistical significance are very similar. The logistic regression results are presented in Appendix A.

inadequate nutrition among low-income children. Rates of low birth-weight births in communities were positively related to the level of anemia and nutritional deficiency, whereas the percentage of noncitizens was inversely related to the level of anemia.

Consistent with the earlier bivariate analysis findings on the relationship between WIC and FSP program participation and EPSDT service utilization, multivariate OLS regression also shows that those who received WIC and FSP benefits, jointly or alone, had a lower rate of utilizing the preventive EPSDT health services than those who did not. Obviously, this finding is contrary to what has been hypothesized. One possible explanation is how the EPSDT health services actually work. If the EPSDT (being the early screening health services for the Medicaid children) triggers signing up for the program (especially WIC program), the EPSDT health services would precede signing up for the programs in terms of the timing of the events. In fact, unlike the adverse health outcomes considered in the study where the vast majority of the population participated in the program before being diagnosed for adverse health outcomes if participated, about 40 percent of WIC participants received EPSDT service first when participated. In other words, if the temporal order is from EPSDT services to WIC and/or FSP program participation not vise versa, it could appear that the WIC/FSP "non-participants" have higher rates of EPSDT services simply because they received EPSDT services before signing up for the programs.

Another interesting finding is that strong cohort effects showing the probability of receiving EPSDT services have increased substantially during the period studied. This finding is consistent with the state's effort to increase EPSDT health services through Medicaid Managed Care during the same period.

Table 5. OLS Regression Results: WIC and FSP Participatin and Child Outcomes										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC and FSP Service Receipt										
None	0.000		0.000		0.000		0.000		0.000	
WIC Only	-0.083	**	-0.131	**	-0.108	**	-0.035	**	-0.218	**
FSP Only	-0.075	**	-0.141	**	-0.110	**	-0.037	**	-0.348	**
Both	-0.077	**	-0.095	**	-0.099	**	-0.037	**	-0.100	**
Race/Ethnicity										
White	0.000		0.000		0.000		0.000		0.000	
Black	0.001		0.037	**	0.001		0.003	*	-0.031	**
Hispanic	-0.027	**	0.052	**	-0.009		0.000		-0.044	**
Gender										
Male	0.000		0.000		0.000		0.000		0.000	
Female	-0.001		-0.003		-0.008	**	-0.002	*	0.004	
Education										
Less than High School	0.000		0.000		0.000		0.000		0.000	
High School/GED	-0.017	**	-0.008	*	-0.004		-0.001		-0.002	
Work Experience										
None	0.000		0.000		0.000		0.000		0.000	
Some	0.002		0.003		0.005		0.003	**	0.028	**
Marital Status										
Never Married	0.000		0.000		0.000		0.000		0.000	
Married	-0.011	**	-0.015	**	-0.006		-0.003	*	-0.027	**
Divorced/Widowed	-0.005		-0.016	*	-0.005		-0.003		0.001	
Mother's Age at Birth	-0.001	*	0.001		0.001	*	0.000		0.000	
Birth Order	0.016	**	0.003		0.003	*	0.000		-0.010	**
Birth Cohort										
1990	0.000		0.000		0.000		0.000		0.000	
1991	0.013	**	0.002		-0.007		0.001		0.126	**
1992	0.009		-0.002		0.005		0.000		0.131	**
1993	0.008		-0.008		0.007		0.001		0.140	**
1994	0.004		-0.007		0.008		0.001		0.139	**
1995	0.000		-0.002		0.014	**	0.001		0.138	**
1996	0.000		-0.001		0.010	*	0.002		0.155	**
Census Tract Characteristics										
% blacks	0.010		-0.132	**	-0.016		-0.009	*	0.040	
% whites	0.008		-0.106	**	0.000		-0.009	*	0.030	
% with high school diploma or GED	-0.016		-0.004		0.001		0.006		-0.019	
% of households below poverty line	0.000		0.036		0.027		-0.003		0.002	
% households moved	0.014		0.021		-0.003		0.011	*	0.008	
% noncitizens	-0.052	**	-0.100	*	-0.055	*	-0.017	*	-0.012	
% low birth weight births	-0.115		0.429	**	-0.030		0.064	*	-1.007	**
% births without adequate prenatal care	0.025		0.197	**	-0.001		0.006		-0.038	
Constant	0.104	**	0.156	**	0.120	**	0.027	*	0.888	**
*<0.05 **<0.01										

(2) Sibling Fixed-Effects Regression Results

In the sibling fixed-effects model, we find the relationships between WIC and FSP participation, jointly or alone, and the outcome variables are very similar to those found in the OLS regression. This finding suggests that the pattern of associations between WIC and FSP program participation and the child outcomes considered in the study held true even after controlling for the 'unobserved' characteristics between siblings with a family (see Table 7). Again, we find that those who did not receive either service had higher child abuse/neglect substantiation report rates then any of the three program participant groups. Like the findings in the OLS model, those children who received WIC or FSP, jointly or alone, consistently had lower levels of health problem than those who received no services for the three health outcomes considered in the study (anemia, failure to thrive, and nutritional deficiency).

When the results on the other control variables are examined, one finds that mother's education level and marital status that were found having statistically significant relationship with some of the adverse health outcomes are no longer significant in the fixed-effect models. This finding is due to the fact that very few mothers while on Medicaid changed their educational attainment and/or marital status during the period.

Once we control for the possible selection bias using the sibling fixed-effects approach, we find that the effect of participating only in WIC program on the EPSDT outcome is no longer statistically significant. However, the inverse relationships between FSP only and WIC-FSP both, and EPSDT service utilization still remain statistically significant. Again, this might suggest the fact that many children receive EPSDT services first and then are referred to WIC and/or FSP benefits.

The findings of the sibling fixed-effects models suggest that, even after controlling for the possible selection bias, there is much empirical evidence of the association between participating in the WIC and FSP programs, jointly or alone, and lower the risk of child maltreatment and lower levels of nutritional health problems.

Table 6. Sibling Fixed-Effects Regression Results: WIC and FSP Participation and Child Outcomes										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC and FSP Service Receipt										
None	0.000		0.000		0.000		0.000		0.000	
WIC Only	-0.073	**	-0.050	**	-0.055	**	-0.022	**	0.019	
FSP Only	-0.114	**	-0.117	**	-0.123	**	-0.048	**	-0.277	**
Both	-0.084	**	-0.080	**	-0.100	**	-0.044	**	-0.065	**
Gender										
Male	0.000		0.000		0.000		0.000		0.000	
Female	0.000		-0.002		-0.009	**	-0.003	*	0.014	*
Education										
Less than High School	0.000		0.000		0.000		0.000		0.000	
High School/GED	-0.001		0.019		0.010		0.003		0.030	
Work Experience										
None	0.000		0.000		0.000		0.000		0.000	
Some	-0.005		0.004		-0.016	*	0.005		0.016	
Marital Status										
Never Married	0.000		0.000		0.000		0.000		0.000	
Married	0.001		-0.016		-0.007		-0.001		-0.014	
Divorced/Widowed	-0.037		-0.033		-0.032		-0.004		-0.035	
Mother's Age at Birth	0.004		-0.001		0.005		0.000		0.006	
Birth Order	0.000		-0.004		-0.001		-0.001		-0.051	**
Birth Cohort										
1990	0.000		0.000		0.000		0.000		0.000	
1991	0.015		0.000		0.007		0.000		0.092	**
1992	0.009		0.006		0.006		0.002		0.106	**
1993	0.005		0.009		0.002		0.002		0.101	**
1994	0.000		0.016		0.005		0.001		0.112	**
1995	-0.007		0.015		-0.003		0.001		0.126	**
1996	-0.022		0.005		-0.005		-0.002		0.165	**
Census Tract Characteristics										
% blacks	0.024		-0.070		0.015		-0.006		0.101	
% whites	0.036		-0.087	*	0.031		-0.004		0.082	
% with high school diploma or GED	-0.016		0.037		-0.007		-0.029	*	-0.100	
% of households below poverty line	-0.003		-0.021		-0.033		-0.005		0.030	**
% households moved	0.075		-0.092		-0.030		-0.028		0.119	
% noncitizens	-0.007		0.033		0.024		-0.003		-0.132	
% low birth weight births	0.163		0.181		-0.031		-0.008		-0.480	
% births without adequate prenatal care	0.087		-0.179	*	0.048		0.000		0.207	
Constant	0.011		0.293	*	0.025		0.070		0.700	**
F(14385, 13609) =	1.760		1.340		1.150		1.050		1.490	
Prob > F =	0.000		0.000		0.000		0.002		0.000	
*<0.05 **<0.01										

(3) Two-Stage Instrumental Variables (IV) Regression Results

Next, we turn our attention to the instrumental variables approach. We fitted three separate models; joint WIC and FSP participation, WIC only, and FSP only, which are instrumented using the distance from home address to WIC local agencies/clinics or to DHS offices. Because the first stage equation which models the relationship between the distance to WIC centers or DHS offices requires bivariate dependent variable (participation or no participation), we compared each program participation status (joint WIC and FSP, WIC only, and FSP only) to no service category (none).

The results are shown in Tables 7-1 through 7-3. In the instrumental models presented, both the estimated coefficients and standard errors are unusually large. We also find there is a negative, but only marginally significant, relationship between the distance to WIC centers and/or DHS offices, which is the instrument used, and the participation variables.

These findings suggest that the fixed-effects sibling method is the more preferable approach given the data used in the study, because the instrumental variables models are somewhat unstable due to the weak relationship between the instrument used in the analysis and the service receipt indicator variable.

In the instrumental variables models presented in Tables 7-1 to 7-3, we find no evidence of any program participation effect on abuse/neglect, anemia, failure to thrive, nutritional deficiency, and EPSDT. We suspect that the limitation of the instrument used in the study (the distance measure) makes the estimations very unstable.

Table 7-1. Two-Stage Instrumental Regression Results: WIC and FSP Combinded Participatin and Child Outcomes										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC and FSP Service Receipt										
None	0.000		0.000		0.000		0.000		0.000	
Both	0.323		0.542		0.930		-0.051		0.178	
Race/Ethnicity										
White	0.000		0.000		0.000		0.000		0.000	
Black	-0.018		-0.007		-0.061		0.003		-0.038	
Hispanic	-0.013		0.079	**	0.028		-0.002		-0.003	
Gender										
Male	0.000		0.000		0.000		0.000		0.000	
Female	-0.001		-0.006		-0.010		-0.002	*	0.007	
Education										
Less than High School	0.000		0.000		0.000		0.000		0.000	
High School/GED	-0.011		0.003		0.015		-0.003		-0.002	
Work Experience										
None	0.000		0.000		0.000		0.000		0.000	
Some	-0.038		-0.063		-0.095		0.005		-0.006	
Marital Status										
Never Married	0.000		0.000		0.000		0.000		0.000	
Married	0.002		0.011		0.036		-0.004		-0.018	
Divorced/Widowed	-0.002		-0.014		-0.008		-0.003		-0.013	*
Mother's Age at Birth	0.000		0.002		0.003	*	0.000		0.001	
Birth Order	0.013	**	-0.009		-0.014		0.001		-0.023	**
Birth Cohort										
1990	0.000		0.000		0.000		0.000		0.000	
1991	0.016	*	0.009		-0.011		0.002		0.151	**
1992	0.008		-0.010		0.003		0.001		0.168	**
1993	0.004		-0.015		-0.002		0.001		0.181	**
1994	0.001		-0.011		-0.001		0.002		0.183	**
1995	-0.009		-0.015		0.006		0.002		0.188	**
1996	-0.010		-0.017		-0.011		0.004		0.202	**
Census Tract Characteristics										
% blacks	0.041	*	-0.117	**	0.038		-0.012		0.046	
% whites	0.039	*	-0.117	**	0.045		-0.014	*	0.058	
% with high school diploma or GED	0.003		0.029		0.091		0.010		0.000	
% of households below poverty line	0.001		0.001		-0.061		0.014		-0.051	
% households moved	0.066		0.068		0.278		-0.026	*	0.084	
% noncitizens	-0.014		-0.006		0.002		-0.004		-0.001	
% low birth weight births	0.001		0.527	*	0.257		0.078		-1.122	**
% births without adequate prenatal care	-0.023		0.200	*	-0.130		0.006		-0.122	
Constant	-0.286		-0.407		-0.858		0.037		0.702	**
*<0.05 **<0.01										

Table 7-2. Two-Stage Instrumental Regression Results: WIC Only Participation and Child Outcomes										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC and FSP Service Receipt										
None	0.000		0.000		0.000		0.000		0.000	
WIC Only	0.845		5.926		-3.638		-0.037		-1.861	
Race/Ethnicity										
White	0.000		0.000		0.000		0.000		0.000	
Black	0.185		0.801		-0.234		0.035		-0.110	
Hispanic	-0.128		-0.659		0.395		-0.001		0.091	
Gender										
Male	0.000		0.000		0.000		0.000		0.000	
Female	-0.012		-0.116		0.067		-0.003		0.029	
Education										
Less than High School	0.000		0.000		0.000		0.000		0.000	
High School/GED	-0.043		-0.105		0.047		-0.006		0.062	
Work Experience										
None	0.000		0.000		0.000		0.000		0.000	
Some	-0.002		0.094		-0.014		0.014	*	-0.096	
Marital Status										
Never Married	0.000		0.000		0.000		0.000		0.000	
Married	-0.025		-0.112		0.046		-0.007		0.032	
Divorced/Widowed	0.032		0.384		-0.197		-0.013		-0.031	
Mother's Age at Birth	-0.004		-0.029		0.014		0.000		0.008	
Birth Order	0.082		0.281		-0.159		-0.002		-0.057	
Birth Cohort										
1990	0.000		0.000		0.000		0.000		0.000	
1991	0.044		-0.073		0.081		0.008		-0.004	
1992	0.023		-0.220		0.167		0.000		-0.022	
1993	-0.060		-0.688		0.467		0.012		0.034	
1994	-0.105		-0.978		0.693		0.019		0.062	
1995	-0.162		-1.260		0.820		0.020		0.058	
1996	-0.208		-1.797		1.106		0.031		0.116	
Census Tract Characteristics										
% blacks	0.093		-1.168		-0.007		0.012		0.059	
% whites	0.006		-1.469		0.284		-0.013		0.093	
% with high school diploma or GED	0.147		1.813		-0.760		0.011		-0.045	
% of households below poverty line	-0.270		-1.763		0.950		0.050		0.229	
% households moved	0.250		0.907		-0.973		-0.032		-0.103	
% noncitizens	0.179		0.777		-0.027		0.000		0.061	
% low birth weight births	0.015		4.662		-1.451		0.335		-0.563	
% births without adequate prenatal care	0.052		0.089		0.162		-0.018		0.116	
Constant	-0.420		-2.055		1.519		-0.024		0.975	
*<0.05 **<0.01										

Table 7-3. Two-Stage Instrumental Regression Results: FSP Only Participation and Child Outcomes									
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT
WIC and FSP Service Receipt									
None	0.000		0.000		0.000		0.000		0.000
FSP Only	-0.061		0.587		1.494		-0.014		1.027
Race/Ethnicity									
White	0.000		0.000		0.000		0.000		0.000
Black	0.034		-0.010		-0.129		0.010		-0.001
Hispanic	-0.043		0.132		0.178		-0.001		0.107
Gender									
Male	0.000		0.000		0.000		0.000		0.000
Female	-0.001		-0.012		-0.020		-0.003		0.004
Education									
Less than High School	0.000		0.000		0.000		0.000		0.000
High School/GED	-0.028	*	0.007		0.043		0.001		0.014
Work Experience									
None	0.000		0.000		0.000		0.000		0.000
Some	0.005		-0.100		-0.255		0.003		-0.024
Marital Status									
Never Married	0.000		0.000		0.000		0.000		0.000
Married	-0.027		0.057		0.139		-0.009		0.001
Divorced/Widowed	-0.038	**	-0.029		-0.063		-0.008		-0.140
Mother's Age at Birth	0.000		0.004		0.010		0.000		0.003
Birth Order	0.022	**	-0.035		-0.067		-0.001		-0.096
Birth Cohort									
1990	0.000		0.000		0.000		0.000		0.000
1991	0.040	**	-0.001		-0.057		0.002		0.362
1992	0.027	*	0.000		0.004		-0.007		0.422
1993	0.027	*	-0.006		0.026		-0.002		0.425
1994	0.024	*	0.019		0.007		0.006		0.472
1995	0.016		0.039		0.112		0.004		0.490
1996	0.040	**	0.034		0.095		0.016		0.571
Census Tract Characteristics									
% blacks	0.018		-0.127		0.247		-0.003		0.190
% whites	0.028		-0.053		0.313		-0.016		0.285
% with high school diploma or GED	-0.043		-0.071		-0.224		0.005		-0.133
% of households below poverty line	-0.001		0.025		0.045		0.042		-0.011
% households moved	-0.090		-0.061		0.197		-0.028		0.122
% noncitizens	0.045		0.101		-0.016		-0.008		-0.004
% low birth weight births	-0.425		0.564		-0.638		0.140		-2.478
% births without adequate prenatal care	0.143		-0.075		-0.493		-0.013		-0.005
Constant	0.060		-0.226		-0.821		-0.004		0.385
*<0.05 **<0.01									

(4) Multilevel Hazard Models

Each of the dependent variables in the models described above is a dichotomous representation of the occurrence of the event of interest at any time during a child's first five years of life. As such, the independent variable describing participation in WIC and/or FSP is constructed to indicate participation in program benefits at any time before the event of interest or the child's fifth birthday. This strategy does not account for the effect that time might have on the events of interest. In order to assess the effect of WIC and FSP participation on the hazard of individual child outcomes, we used multilevel hazard models. There were four levels included in the models that we ran. They are: the census tract, the mother, the child, and the child's participation in WIC and FSP over time. We used aML software to run these models.

Table 8 presents the results of the model including three time-varying covariates of program participation status: WIC only, FSP only, and WIC-FSP together. Each dummy variable takes a value of 1 for a month according to a child's program participation status. Like the results of the sibling fixed-effects models, we found a significant and negative relationship between WIC and FSP participation, jointly or alone, and the likelihood of indicated abuse or neglect. We also found that those children who received WIC or FSP, jointly or alone, had lower levels of anemia, failure to thrive, and nutritional deficiency than those who received no services (except for the nutritional deficiency, where FSP only participation had no effect). However, the multilevel hazard models also show there are inverse relationships between the WIC and FSP program participation and EPSDT service utilization. Again, this might suggest the fact that many children receive EPSDT services first and then are referred to WIC and/or FSP benefits.

Of particular note is an unusual gender effect in this model. Female children were significantly less likely to have a diagnosis of failure to thrive. In the absence of an explanation for this result, it may signal additional unobserved characteristics of the children in this Medicaid population that affect the likelihood of abuse or neglect.

The aML software that we used to estimate these multilevel hazard models allows the user to incorporate a control for unobserved heterogeneity at the several levels of the model. We included a control for heterogeneity at the mother level in the form of a univariate normally-distributed residual. In all cases, even in the presence of significant heterogeneity at the mother level, the size, direction, and significance of the WIC and FSP indicators were consistent with the models presented in Table 8.

Table 8. Multilevel Hazard Model: WIC and FSP Participatin and Child Outcomes										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC only receipt	-2.029	***	-1.716	***	-2.382	***	-2.241	***	-2.265	***
FSP only receipt	-0.834	***	-0.980	***	-0.846	***	-58.970		-0.921	***
WIC+FSP receipt	-1.491	***	-1.431	***	-1.736	***	-1.594	***	-1.229	***
Race/Ethnicity										
Black	0.042		0.188	**	0.059		0.530		-0.126	***
Hispanic	-1.325	***	0.250	***	-0.414	***	0.055		-0.144	***
Gender										
Female	-0.038		-0.071	*	-0.227	***	-0.374		-0.002	
Education										
High School/GED	-0.481	***	-0.027		0.019		-0.315		0.061	***
Work Experience										
Some	0.156	*	0.152	***	0.182	**	0.244		0.135	***
Marital Status										
Married	-0.354	***	-0.034		-0.090		-0.060		-0.033	*
Divorced/Widowed	-0.053		0.033		0.083		-155.718		-0.020	
Mother's Age at Birth	-0.016	*	-0.007		0.011		0.039		-0.002	
Birth Order	0.299	***	0.030	*	0.079	***	-0.078		-0.046	***
Birth Cohort										
1991	0.360	**	0.095		-0.370	**	0.591		0.504	***
1992	0.415	***	0.106		0.111		0.124		0.633	***
1993	0.441	***	0.110		0.317	**	0.416		0.678	***
1994	0.271		0.183	**	0.209		0.380		0.765	***
1995	0.195		0.285	***	0.487	***	0.454		0.804	***
1996	0.226		0.337	***	0.490	***	0.617		0.931	***
1997	-0.047		0.057		0.307	*	0.844		0.908	***
1998	-0.831	**	-0.141		0.507	***	0.137		0.966	***
1999	-0.589	**	-0.515	***	-0.283		-59.114		0.913	***
2000	-2.487	***	-0.878	***	-1.084	***	-1.184		1.051	***
Census Tract Characteristics										
% Blacks	0.124		-1.236	***	-0.317		-2.235		0.294	***
% Whites	0.550		-1.127	***	0.066		-2.205		0.427	***
% with high school diploma or GED	-0.348		0.139		0.243		3.273		-0.104	
% households moved	0.040		0.113		0.537		0.869		0.045	
% noncitizens	0.595		0.572	***	0.461		0.906		0.185	***
% of households below poverty line	-2.259	***	-0.912	***	-1.655	**	-2.029		-0.156	*
% low birth weight births	-3.672	*	3.924	***	-1.748		9.352		-3.842	***
% births without adequate prenatal care	0.960		1.983	***	0.721		-0.095		-0.298	**
Duration Splines										
Dur 0-180 days	0.005	***	0.009	***	-0.003	***	-0.014	***	-0.002	***
Dur 180-365 days	-0.001		0.000		0.001		-0.001		-0.004	***
Dur 365-730 days	0.001		-0.001	**	-0.001	*	0.003		-0.001	***
Dur 730-1095 days	0.000		0.001	***	-0.001	*	-0.003		0.001	***
Dur> 1095 days	-0.001		0.000		-0.001	**	-0.002		0.001	***
Constant	-10.518	***	-10.407	***	-9.516	***	-12.949	***	-5.471	***
ln-L	-7393.800		-22767.360		-9098.680		-911.780		26065.710	
*<0.1 **<0.05 ***<0.01										

Limitations of the Research and Future Directions

Because our primary data source is administrative data collected and maintained by agencies in the course of programmatic activities for the purposes of client-level tracking, service delivery, or decision making-essentially, nonresearch activities-there are some disadvantages to using administrative data. First, some time-varying characteristics, such as education, marriage, or work experience, were measured at the point of program entry. Second, those who moved out of the state were lost entirely and could not be differentiated from those ending a participation spell. Third, we had to rely on completeness of diagnosis provided through Medicaid claims data to identify our key dependent variables such as health problems and EPSDT service utilization. Although the reliability of the data is tested and it has been used successfully in previous research (see, for example, Lee, Mackey-Bilaver, & Goerge, 2000, and Bilaver et al., 1999), there is still a possibility of not capturing all health problems relying on Medicaid claims data.

It also should be noted that we could not use Chicago Public Schools' central information system data containing pre-K health screen result information for the height and weight dependent variables as proposed because of the poor quality of the data. There is a need to determine whether there are better administrative data on later development of low-income children for investigating the long-term effects of WIC and FSP participation.

We also found that the instrument (which is the distance to WIC local agencies or clinics) used for the IV models is somewhat limited. There is a negative, but only marginally significant, relationship between the distance to WIC clinics and the WIC participation variable. These findings suggest that the sibling fixed-effects method is the more preferable approach given the data used in the study, because the instrumental variables models are somewhat unstable due to the weak relationship between the instrument used in the analysis and the participation indicator variable.

It is also important to emphasize that the control for mother level unobserved heterogeneity in the multilevel hazard models may not be an adequate control for selection bias. To the extent that unobserved mother's characteristics affect both the child outcome and the likelihood that a child participates in WIC or FSP, the WIC and FSP coefficients may still be biased by the correlation between the unobserved heterogeneity and the residual.

The significance of using administrative data to answer research questions should not be underestimated. Most previous research on effects of WIC and FSP participation relied on surveys based on samples. By contrast, we followed the entire Medicaid population who were born between 1990 and 2000, and enrolled in Medicaid within a month from birth to track their WIC and FSP program participation patterns and outcomes. The fact that administrative data represent a complete population rather than a sample increases the generalizability of the study results. As Hoynes (1996), who also used administrative data to assess AFDC use in California, points out, full population coverage, albeit within a state, allows one to identify important subgroups of recipients. It also allows one to document the prevalence of low-incidence problems (such as child

maltreatment) or hard-to-study populations, and allows one to identify indicators at small geographic or community levels (see also Brady & Snow, 1997; Goerge, 1995).

Conclusions

Utilizing a unique individual-level longitudinal database linking administrative datasets on WIC and Food Stamp program (FSP) participation, Medicaid enrollment and claims, and child abuse and neglect reports in Illinois, this study examined the relationships between WIC and Food Stamp program participation and young children's health and maltreatment outcomes. More specifically, we examined the relationships between three types of program participation (joint WIC and FSP, WIC only, and FSP only) and the rates of having substantiated child abuse/neglect reports, being diagnosed with health problems associated with inadequate nutrition (anemia, failure to thrive, and nutritional deficiency), and receiving EPSDT services.

We used sibling fixed-effects model and two-stage instrumental variables model in order to isolate more accurately the program participation effects. With the data utilized for the study, we find the sibling fixed-effects model works better for neutralizing the selectivity. By comparing the results of sibling-fixed effects models with those of ordinary least squares models, we report no obvious evidence of selection bias in the identified relationships between WIC and FSP participation and a majority of key dependent variables examined in the study.

Ordinary least squares models, without controlling for selection bias, show that the receipt of WIC benefits and food stamps, jointly or alone, is associated with a lower level of substantiated child abuse and neglect. The same models also show that the receipt of WIC and food stamps is inversely related to the incidence of health problems associated with inadequate nutrition among low-income children. More specifically, the receipt of WIC and food stamps, jointly or alone, is associated with lower risk of being diagnosed with anemia, failure to thrive, and other nutritional deficiencies.

When we control for the possible selection bias using sibling fixed-effects models, we find no evidence of selection bias in many of the OLS results. In sibling fixed-effects models, we find that those who did not receive either service had higher child abuse/neglect substantiation report rates than any of the three program participant groups. Those children who received WIC or FSP, jointly or alone, consistently had lower levels of health program than those who received no services for the three health outcomes considered in the study (anemia, failure to thrive, and nutritional deficiency).

Taking full advantage of the longitudinal nature of the data, we also employed multilevel hazard models in the study. The findings in the multilevel hazard models are especially noteworthy because the models specifically take into account the timing of the events. Even after controlling for unobserved heterogeneity in most of the multilevel hazard models, the results show a statistically significant relationship betwen the likelihood of abuse and neglect and participation in WIC and FSP, jointly or alone. This finding is significant because it offers some evidence that participation in programs such as WIC and FSP that offer family supports not directly aimed at preventing child abuse and neglect may protect children. In the multilevel analyses, we also found that those children who received WIC or FSP, jointly or alone, had lower levels of anemia, failure

to thrive, and nutritional deficiency than those who received no services (except for the nutritional deficiency, where FSP only participation had no effect).

The findings of the relationships between WIC and FSP participation, jointly or alone, and lower risk of being reported and substantiated for child maltreatment and lower levels of health problem is significant indicators of benefits of WIC and FSP participation among low-income young children.

This research project has built on our existing, successful state-researcher collaborations in Illinois. In addition to answering key research questions surrounding the effects of WIC and FSP participation, the ongoing development and use of administrative data in Illinois will provide a model for other states and may promote the investment necessary to develop administrative data into a more readily available resource for research.

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Appendix A. Program Participation and Adverse Health Outcomes

The program participation coding scheme used in the OLS and Fixed-Effects models of the study (i.e., only considering WIC and/or FSP participation before being diagnosed as having an adverse health outcome) might lead to a different selection bias problem. For example, since children with the adverse health outcome who then participated in the WIC program are defined as "non-participants," to the extent that WIC identifies the children with the adverse health outcomes and helps them to sign up for the program, the probability of finding the adverse health outcomes among the "non-participants" would be overestimated. Below, we present the actual statistics on the WIC participation and being diagnosed as having anemia to illustrate this point.

Time 1	Time 2	Time 3	Percent of the population
Anemia present	WIC participation		1.0%
Anemia present	No WIC participation		1.3%
No anemia	WIC participation	Anemia	7.7%
No anemia	WIC participation	No anemia	71.3%
No anemia	No WIC participation		18.8%

As shown in the above table, the proportion of the children who were diagnosed as having anemia at "time 1" and later participated in WIC was almost the same as that of those being diagnosed for anemia and never participated in WIC. This finding shows that being diagnosed for anemia in fact triggers signing up for the WIC program for the significant number of children on Medicaid. Treating this population as "non-participants" might overly inflate the probability of finding anemia among the "non-participant" group. However, conceptually it is also problematic to count this population as "participants" because the cause (program participation) should precede the effect (anemia) in time to infer a causal relationship between the two events.

In order to handle this problem in a non-experimental study, the best approach might be to take advantage of the longitudinal nature of the data taking into account the timing of the different events. For example, the case of "anemia present" at time 1 and "WIC participation" at time 2 presented in the first row of the above table will be treated as an ended spell at the time of being diagnosed for anemia having reached the outcome event.

This report presents the results from both approaches. The OLS, fixed-effects, and Instrumental Variables 2 stage least squares models use the 'cross-sectional' coding scheme of the program participation variable taking the values of 1 when being observed before the event of diagnosis of adverse health outcomes. The Multilevel Hazard Model takes the full advantage of the longitudinal nature of the data setting up the program participation statuses as time-varying covariates. When we compare the results between the two approaches, we find that the OLS, fixed-effects, and Multilevel Hazard models show similar results. This could be interpreted as an indirect evidence of supporting the program participation coding scheme used in the OLS, fixed-effects, and Instrumental Variables 2 stage least squares models (which was to reduce the "underestimation" problem of program effect) in the study.

Appendix B. Logistic Regression Results: WIC and FSP Effects on Child Outcomes

Appendix B. Logistic Regression Results: WIC and FSP Participatin and Child Outcomes										
(Odds Ratios are reported)										
	Abuse/Neglect		Anemia		Failure to Thrive		Nutritional Deficiency		EPSDT	
WIC and FSP Service Receipt										
None	1.000		1.000		1.000		1.000		1.000	
WIC Only	0.017	**	0.258	**	0.128	**	0.038	**	0.224	**
FSP Only	0.257	**	0.234	**	0.133	**	0.036	**	0.134	**
Both	0.239	**	0.441	**	0.204	**	0.036	**	0.425	**
Race/Ethnicity										
White	1.000		1.000		1.000		1.000		1.000	
Black	0.992		1.656	**	1.053		2.506	*	0.804	**
Hispanic	0.229	**	1.841	**	0.772		1.064		0.742	**
Gender										
Male	1.000		1.000		1.000		1.000		1.000	
Female	0.960		0.968		0.793	**	0.659	*	1.030	
Education										
Less than High School	1.000		1.000		1.000		1.000		1.000	
High School/GED	0.620	**	0.908	*	0.893		0.792		0.984	
Work Experience										
None	1.000		1.000		1.000		1.000		1.000	
Some	1.062		1.033		1.152		1.509		1.196	**
Marital Status										
Never Married	1.000		1.000		1.000		1.000		1.000	
Married	0.758	**	0.832	**	0.859		0.546		0.831	**
Divorced/Widowed	0.912		0.813		0.884		0.404		0.993	
Mother's Age at Birth	0.989		1.008		1.018	*	1.026		1.001	
Birth Order	1.377	**	1.028		1.067	*	0.986		0.942	**
Birth Cohort										
1990	1.000		1.000		1.000		1.000		1.000	
1991	1.417	**	1.026		0.758		1.151		1.950	**
1992	1.287		0.978		1.188		1.046		2.025	**
1993	1.292		0.918		1.241		1.365		2.145	**
1994	1.143		0.933		1.266		1.685		2.138	**
1995	1.030		0.987		1.486	**	1.570		2.126	**
1996	1.023		0.998		1.356	*	2.051		2.400	**
Census Tract Characteristics										
% blacks	1.192		0.266	**	0.643		0.121	*	1.312	
% whites	1.179		0.275	**	0.995		0.093	**	1.284	
% with high school diploma or GED	0.712		1.131		1.068		8.053		0.832	
% of households below poverty line	0.913		1.202		2.031		0.592		1.036	
% households moved	1.621		1.362		0.948		8.824		1.060	
% noncitizens	0.138	*	0.392	*	0.198	*	0.048		0.900	
% low birth weight births	0.037		46.772	**	0.432		258,235.000	*	0.003	**
% births without adequate prenatal care	2.105		10.758	**	1.055		3.108		0.722	
*<0.05 **<0.01										